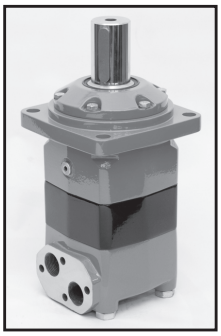
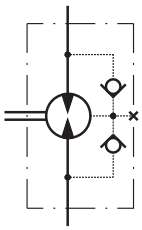
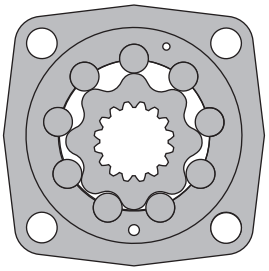
HYDRAULIC MOTORS MV



APPLICATION

» Conveyors
» Metal working machines
» Agricultural machines
» Road building machines
» Mining machinery
» Food industries
» Special vehicles
» Plastic and rubber machinery etc.





CONTENTS

OPTIONS

» Model - Disc valve, roll-gerotor
» Flange and wheel mount
» Short motor
» Speed sensoring
» Side ports
» Shafts - straight, splined and tapered
» BSPP ports
» Other special features

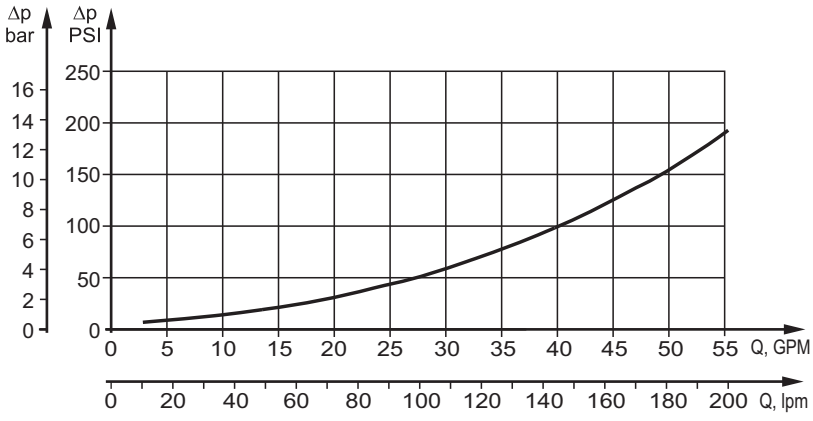
GENERAL

Max. Displacement, cm^3/rev [in^3/rev]	801,8 [48.91]
Max. Speed, [RPM]	630
Max. Torque, daNm [lb-in]	cont.: 188 [16650] int.: 211 [18650]
Max. Output, kW [HP]	64 [85.8]
Max. Pressure Drop, bar [PSI]	cont.: 200 [2900] int.: 240 [3480]
Max. Oil Flow, lpm [GPM]	240 [63.4]
Min. Speed, [RPM]	5
Permissible Shaft Loads, daN [lbs]	P_a=1500 [3300]
Pressure fluid	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)
Temperature range, ^{O}C [^{O}F]	-40÷140 [-40÷284]
Optimal Viscosity range, mm^2/s [SUS]	20÷75 [98÷347]
Filtration	ISO code: 18/16/13 According to ISO 4406-1999

Oil flow in drain line

Pressure drop bar [PSI]	Viscosity mm^2/s [SUS]	Oil flow in drain line lpm [GPM]
140 [2030]	20 [98]	3 [.793]
	35 [164]	2 [.528]
210 [3045]	20 [98]	6 [1.585]
	35 [164]	4 [1.057]

Pressure Losses



SPECIFICATION DATA

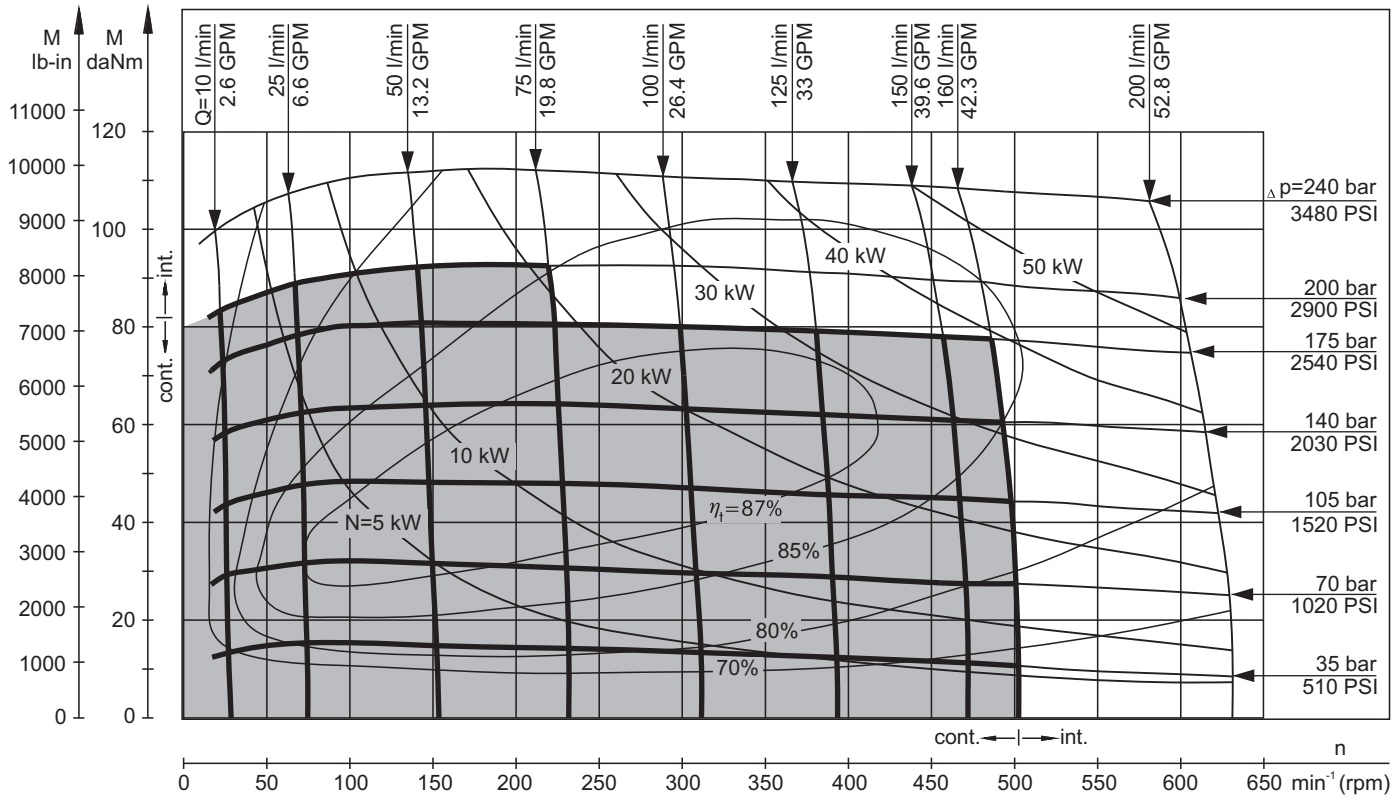
Type		MV 315	MV 400	MV 500	MV 630	MV 800
Displacement, cm^3/rev [In^3/rev]		314,5 [19.18]	400,9 [24.45]	499,6 [30.48]	629,1 [38.38]	801,8 [48.91]
Max. Speed, [RPM]	Cont.	510	500	400	320	250
	Int.*	630	600	480	380	300
Max. Torque daNm [lb-in]	Cont.	92 [8150]	118 [10450]	146 [12950]	166 [14700]	188 [16650]
	Int.*	111 [9800]	141 [12500]	176 [15550]	194 [17150]	211 [18650]
	Peak**	129 [11400]	164 [14500]	205 [18150]	221 [19550]	247 [21850]
Max. Output kW [HP]	Cont.	42,5 [57]	53,5 [71.7]	53,5 [71.7]	48 [64.4]	42,5 [57]
	Int.*	51 [68.4]	64 [85.8]	64 [85.8]	56 [75]	48 [64.4]
Max. Pressure Drop bar [PSI]	Cont.	200 [2900]	200 [2900]	200 [2900]	180 [2610]	160 [2320]
	Int.*	240 [3480]	240 [3480]	240 [3480]	210 [3050]	180 [2610]
	Peak**	280 [4060]	280 [4060]	280 [4060]	240 [3480]	210 [3050]
Max. Oil Flow lpm [GPM]	Cont.	160 [42.3]	200 [52.8]	200 [52.8]	200 [52.8]	200 [52.8]
	Int.*	200 [52.8]	240 [63.4]	240 [63.4]	240 [63.4	240 [63.4]
Max. Inlet Pressure bar [PSI]	Cont.	210 [3050]	210 [3050]	210 [3050]	210 [3050]	210 [3050]
	Int.*	250 [3620]	250 [3620]	250 [3620]	250 [3620]	250 [3620]
	Peak**	300 [4350]	300 [4350]	300 [4350]	300 [4350]	300 [4350]
Max. Return Pressure with Drain Line bar [PSI]	Cont.	140 [2040]	140 [2040]	140 [2040]	140 [2040]	140 [2040]
	Int.*	175 [2540]	175 [2540]	175 [2540]	175 [2540]	175 [2540]
	Peak**	210 [3050]	210 [3050]	210 [3050]	210 [3050]	210 [3050]
Max. Starting Pressure with Unloaded Shaft, bar [PSI]		8 [120]	8 [120]	8 [120]	8 [120]	8 [120]
Min. Starting Torque daNm [lb-in]	At max. press. drop Cont.	71 [6300]	91 [8100]	113 [10000]	133 [11800]	151 [13400]
	At max. press. drop Int.*	85 [7500]	109 [9600]	136 [12000]	155 [13700]	170 [15000]
Min. Speed*, [RPM]**		10	9	8	6	5
Weight, kg [lb]	MV	31,8 [70.1]	32,6 [71.9]	33,5 [73.8]	34,9 [76.9]	36,5 [80.5]
	MVW	32,4 [71.4]	33,2 [73.2]	34,1 [75.2]	35,5 [78.3]	37,1 [81.8]
	MVS	22,7 [50]	23,5 [51.8]	24,4 [53.8]	25,6 [56.4]	27,7 [61.1]

* Intermittent operation: the permissible values may occur for max. 10% of every minute.
** Peak load: the permissible values may occur for max. 1% of every minute.
*** For speeds lower than given, consult factory or your regional manager.

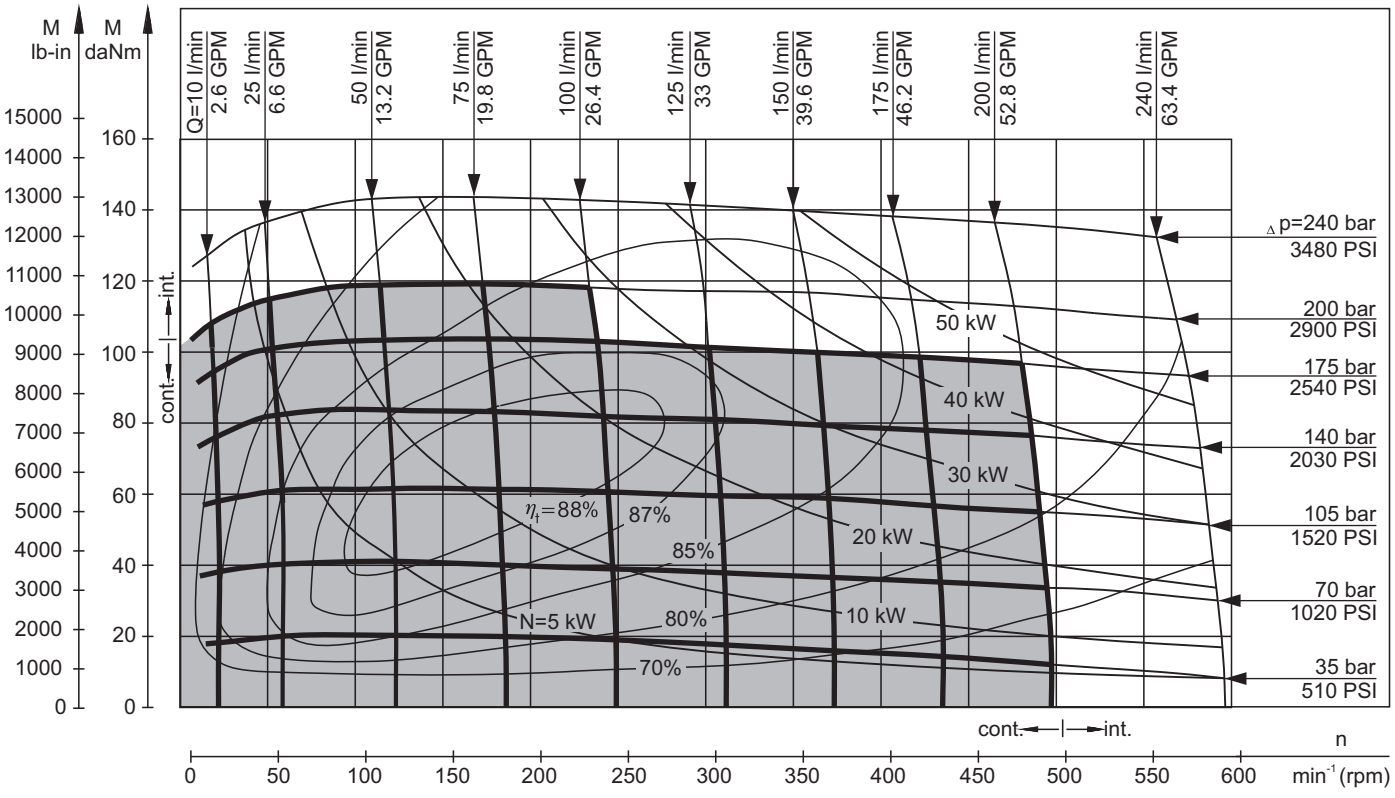
1. Intermittent speed and intermittent pressure must not occur simultaneously.
2. Recommended filtration is per ISO cleanliness code 20/16. A nominal filtration of 25 micron or better.
3. Recommend using a premium quality, anti-wear type mineral based hydraulic oil HLP(DIN51524) or HM (ISO 6743/4). If using synthetic fluids consult the factory for alternative seal materials.
4. Recommended minimum oil viscosity 13 mm^2/s [70 SUS] at 50°C [122°F].
5. Recommended maximum system operating temperature is 82°C [180°F].
6. To assure optimum motor life fill with fluid prior to loading and run at moderate load and speed for 10-15 minutes.

FUNCTION DIAGRAMS

MV 315



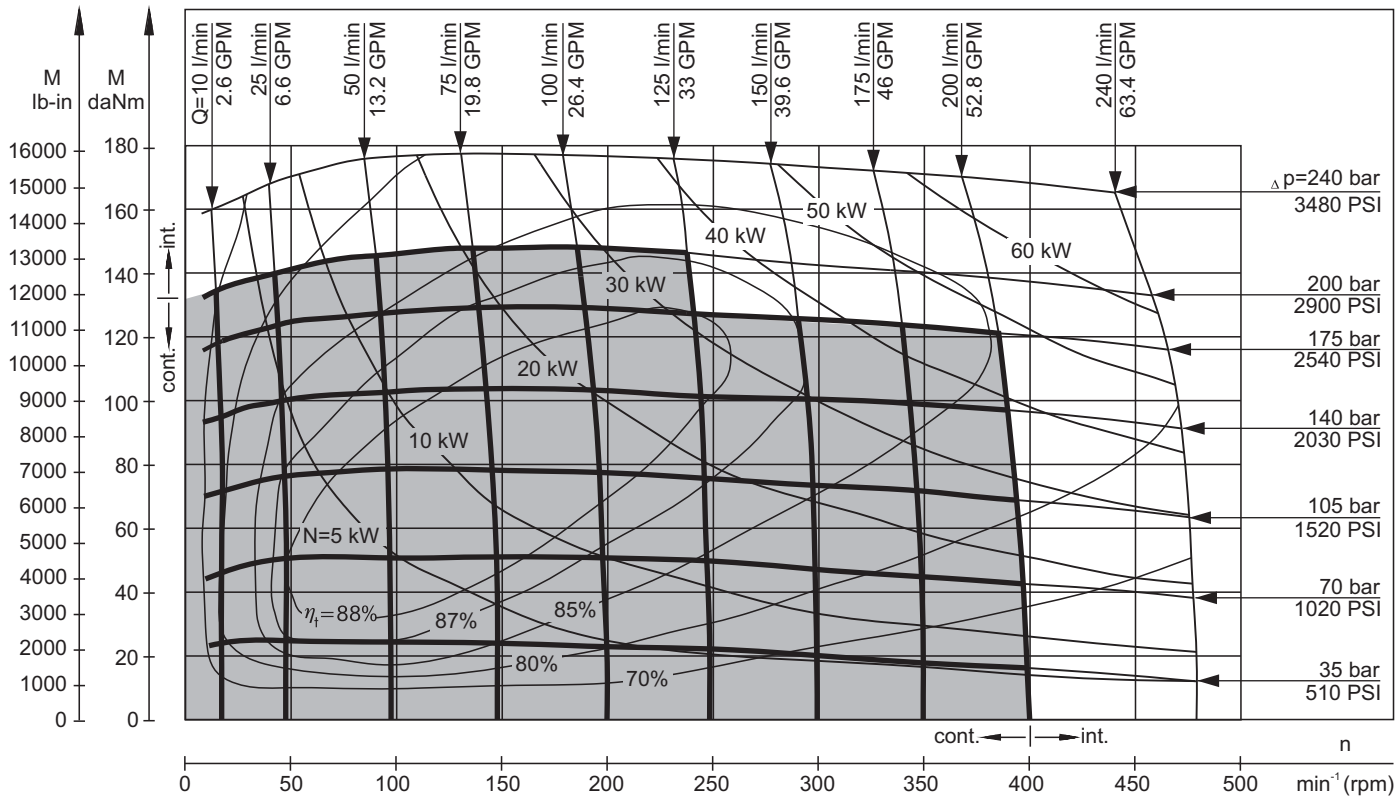
MV 400



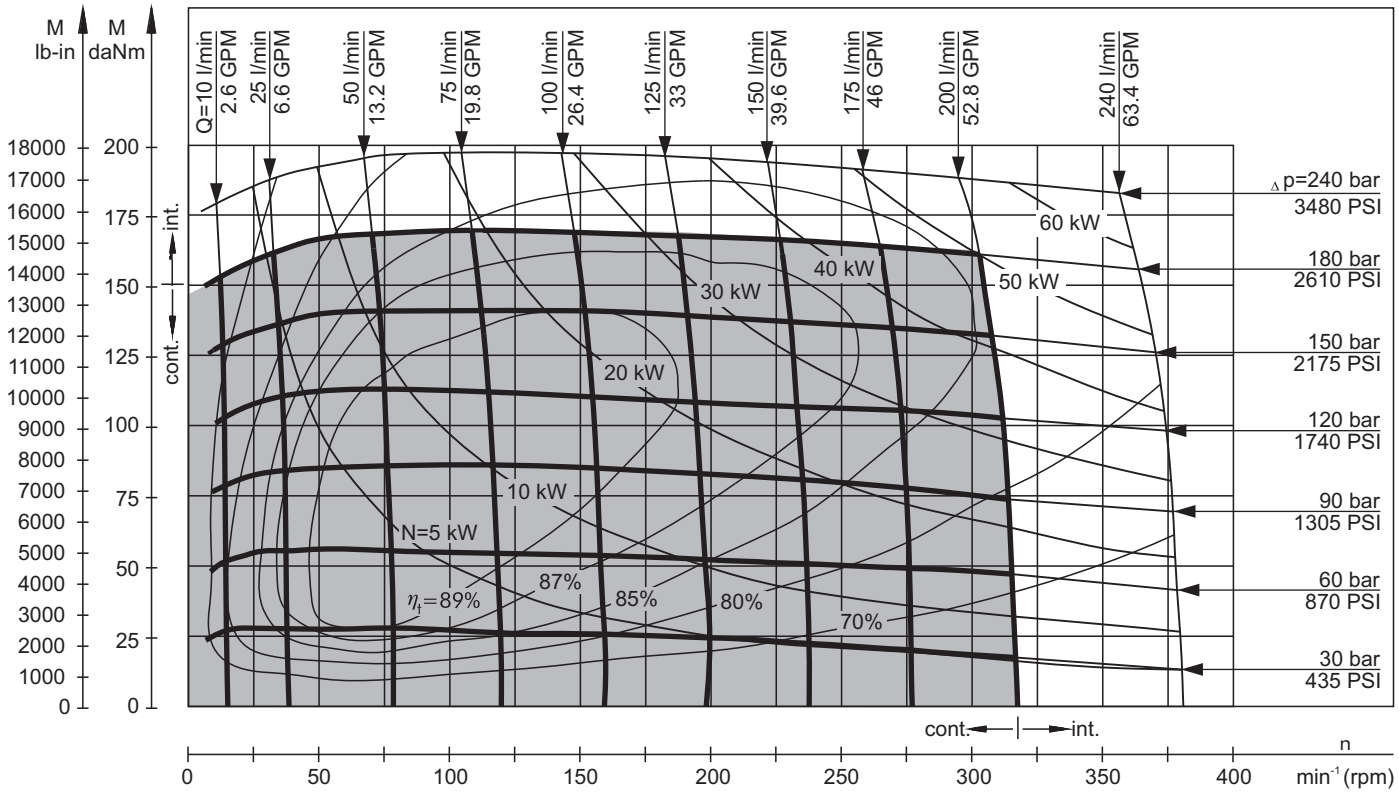
The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

FUNCTION DIAGRAMS

MV 500



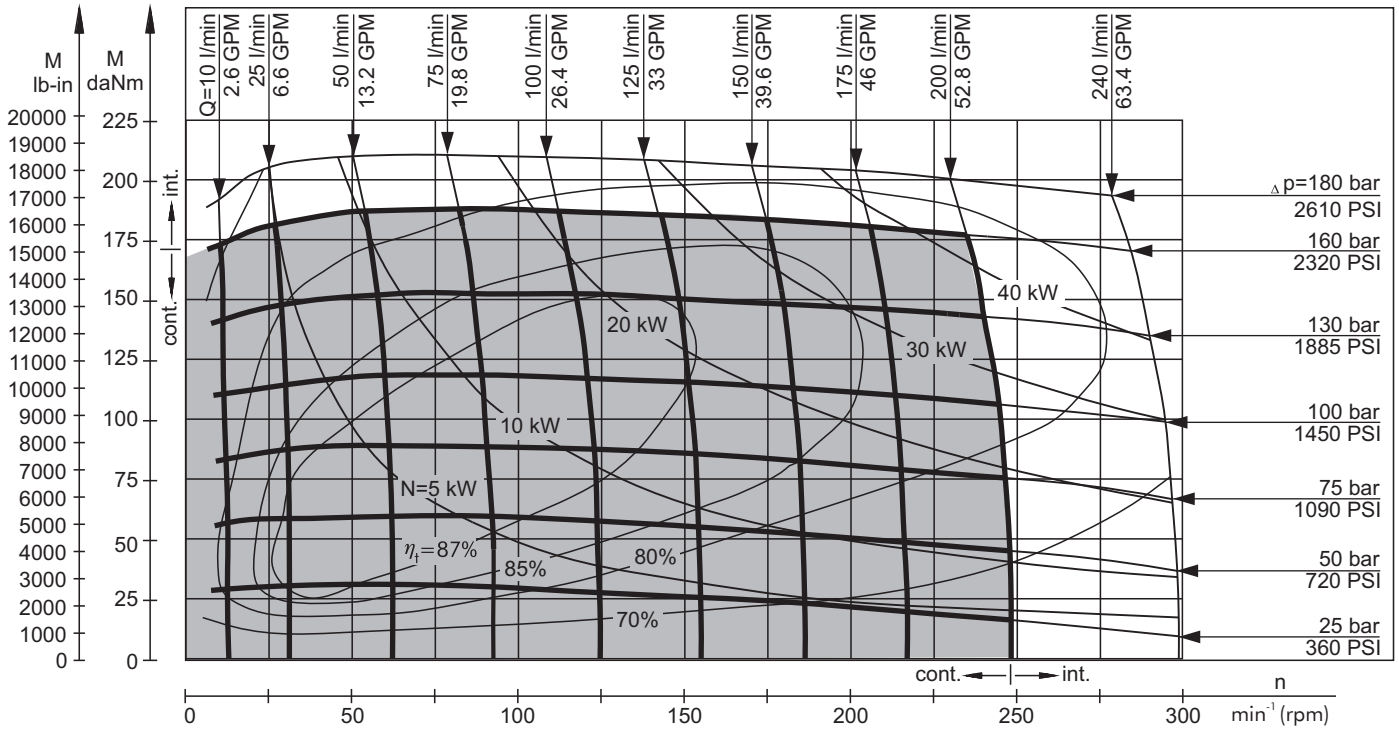
MV 630



The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

FUNCTION DIAGRAMS

MV 800

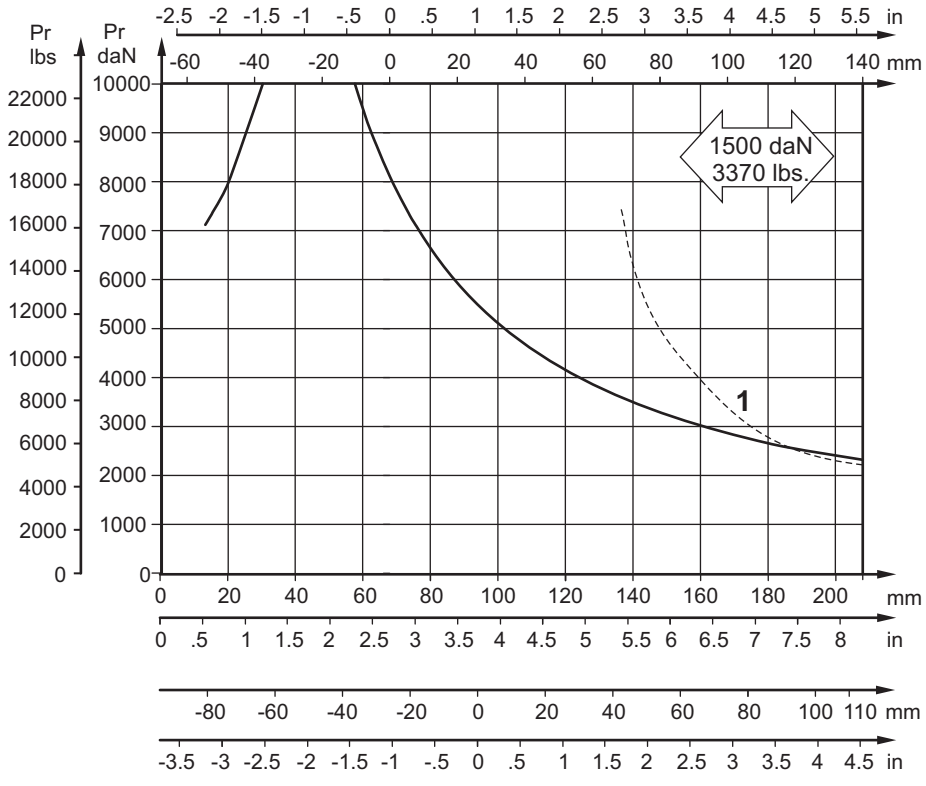


The function diagrams data is for average performance of randomly selected motors at back pressure 5÷10 bar [72.5÷145 PSI] and oil with viscosity of 32 mm²/s [150 SUS] at 50°C [122°F].

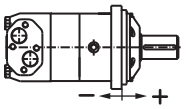
PERMISSIBLE SHAFT LOADS

The output shaft runs in tapered bearings that permit high axial and radial forces. The permissible radial load on the shaft is shown for an axial load of 0 N as function of the distance from the mounting flange to the point of load application. The curves apply to a B10 bearing life of 2000 hours at 100 RPM .

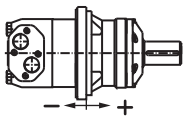
Curve "**1**" shows max. radial shaft load. Any shaft load exceeding the values shown by the curve will seriously reduce motor life.



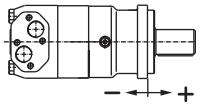
Mounting Flange:



Standard

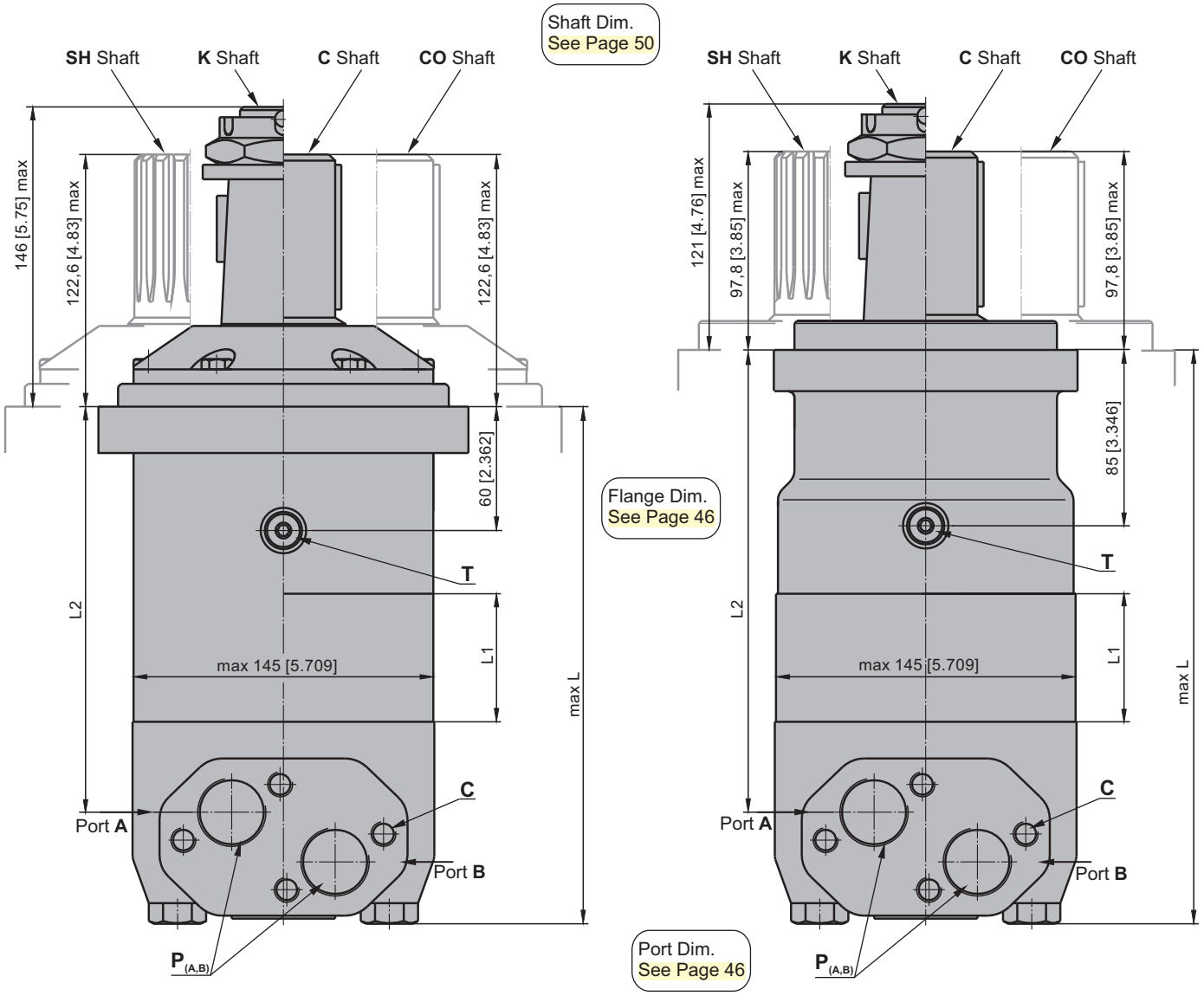


W - Wheel



SAE C

DIMENSIONS and MOUNTING DATA - MV and MVC



C : 4xM12 - 12 mm [.47 in] depth
P$_{(A,B)}$: 2xG1 - 20 mm [.79 in] depth
T : G 1/4 - 12 mm [.47 in] depth

Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

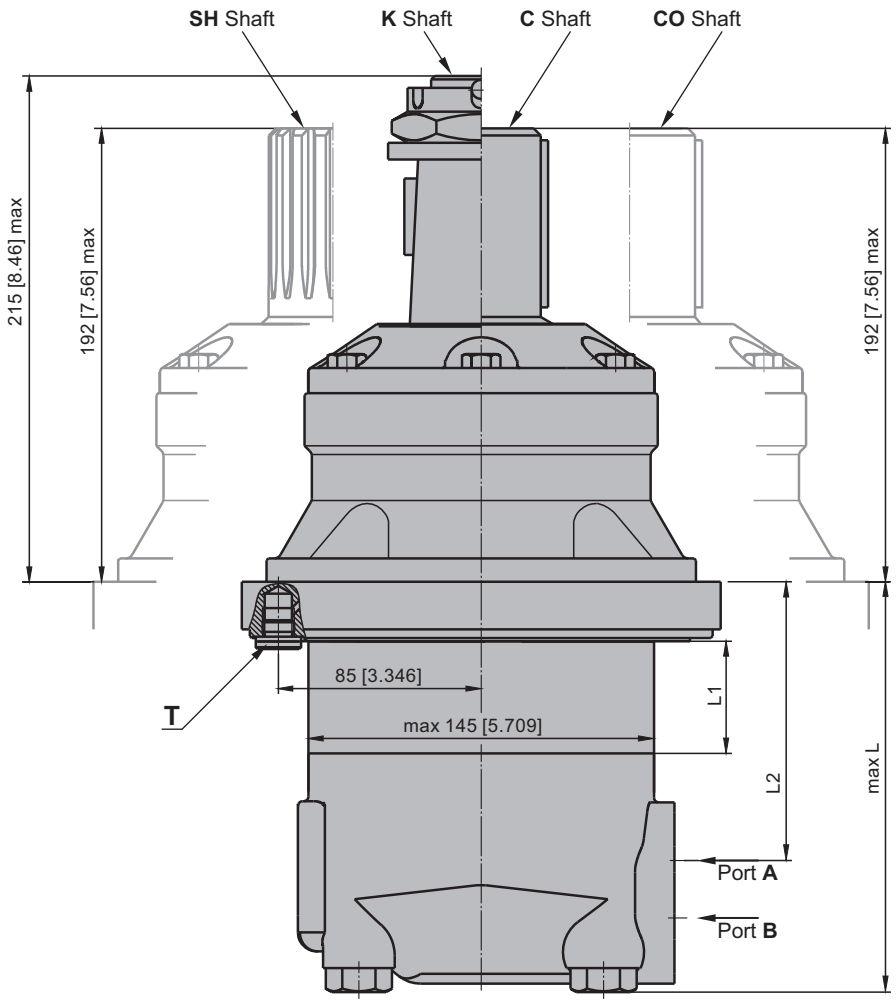
Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

mm [in]

Type	L, mm [in]	L2, mm [in]	Type	L, mm [in]	L2, mm [in]	*L1, mm [in]
MV 315	214,5 [8.45]	160 [6.30]	MVC 315	239,0 [9.41]	185,5 [7.30]	22,0 [.87]
MV 400	221,5 [8.72]	167 [6.58]	MVC 400	246,0 [9.68]	192,5 [7.58]	29,0 [1.14]
MV 500	229,5 [9.04]	175 [6.89]	MVC 500	254,0 [10.00]	200,5 [7.89]	37,0 [1.46]
MV 630	240,0 [9.45]	186 [7.32]	MVC 630	264,5 [10.41]	211,0 [8.31]	47,5 [1.87]
MV 800	254,0 [10.0]	200 [7.87]	MVC 800	278,5 [10.96]	225,0 [8.86]	61,5 [2.42]

* The width of the roll-gerotor is 4 mm [.157 in.] greater than L1.

DIMENSIONS and MOUNTING DATA - MVW



Shaft Dim. See Page 50
Flange Dim. See Page 46
Port Dim. See Page 46

C : 4xM12 - 12 mm [.47 in] depth
$P_{(A,B)}$: 2xG1 - 20 mm [.79 in] depth
T : G 1/4 - 12 mm [.47 in] depth

Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

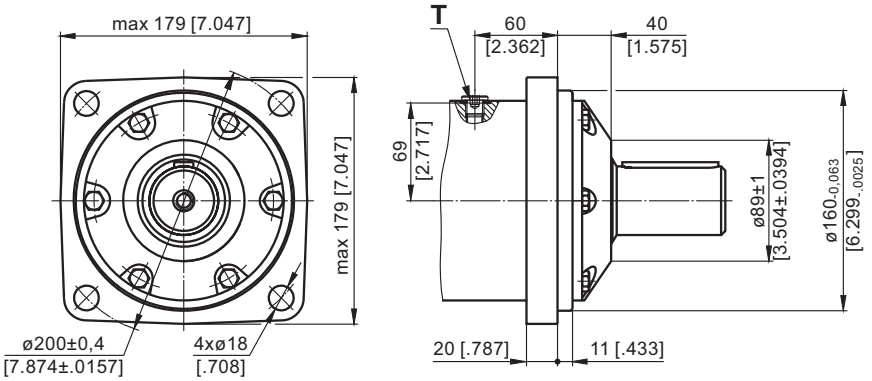
mm [in]

Type	L, mm [in]	L_2, mm [in]	*L_1, mm [in]
MVW 315	146 [5.75]	90,6 [3.57]	22,0 [.87]
MVW 400	153 [6.02]	97,6 [3.84]	29,0 [1.14]
MVW 500	161 [6.34]	105,6 [4.16]	37,0 [1.46]
MVW 630	172 [6.77]	116,1 [4.57]	47,5 [1.87]
MVW 800	185 [7.28]	130,1 [5.12]	61,5 [2.42]

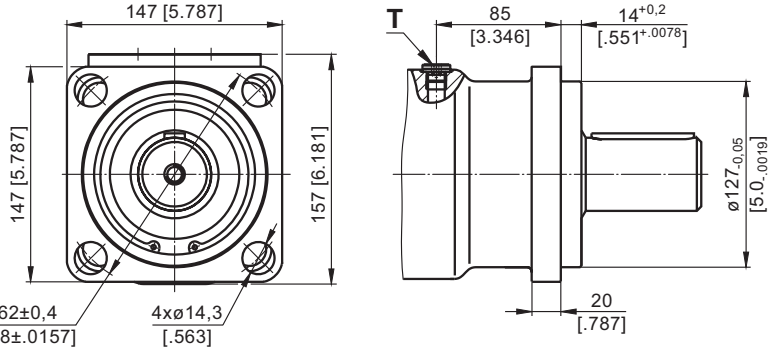
* The width of the roll-gerotor is 4 mm [.157 in] greater than L_1.

MOUNTING

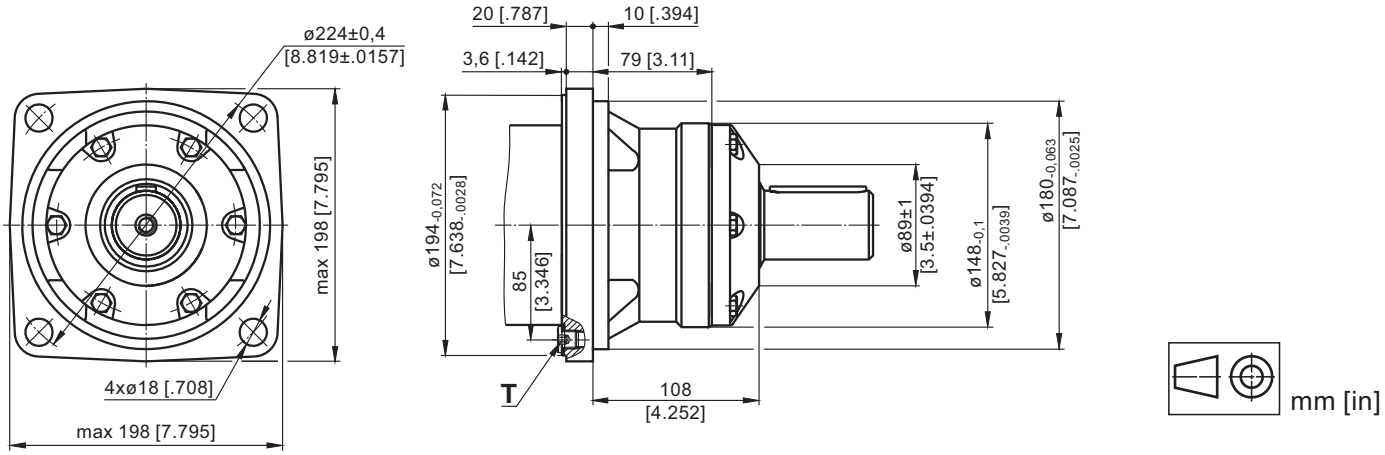
Square Mount (4 Holes)



C SAE C Mount



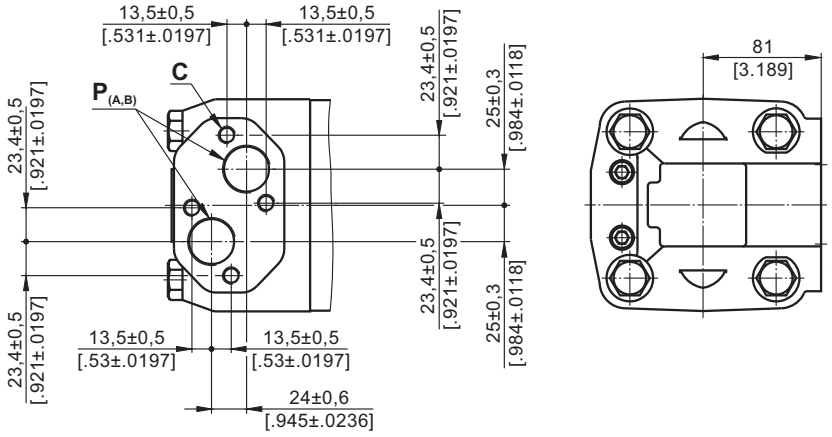
W Wheel Mount



mm [in]

PORTS

Side Ports



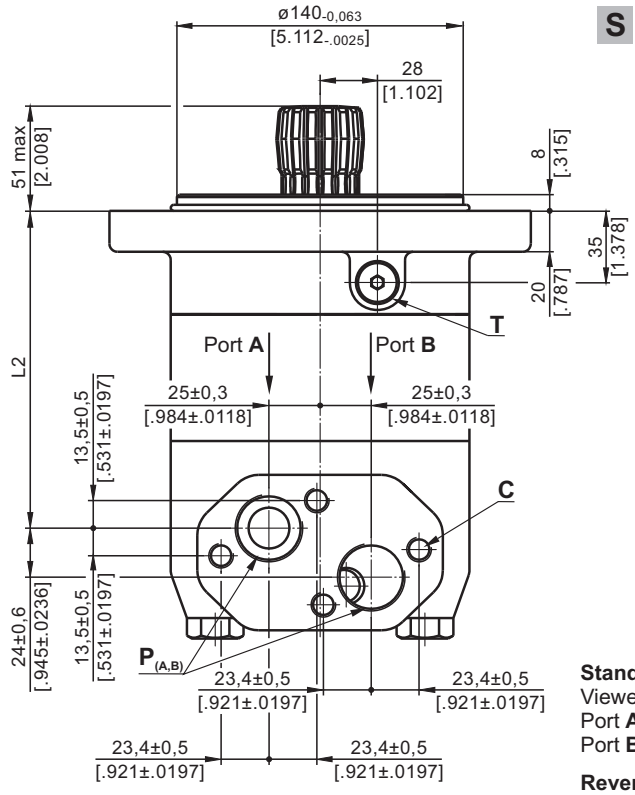
C : 4xM12 - 12 mm [.47 in] depth
P(A,B): 2xG1 - 20 mm [.79 in] depth
T : G 1/4 - 12 mm [.47 in] depth

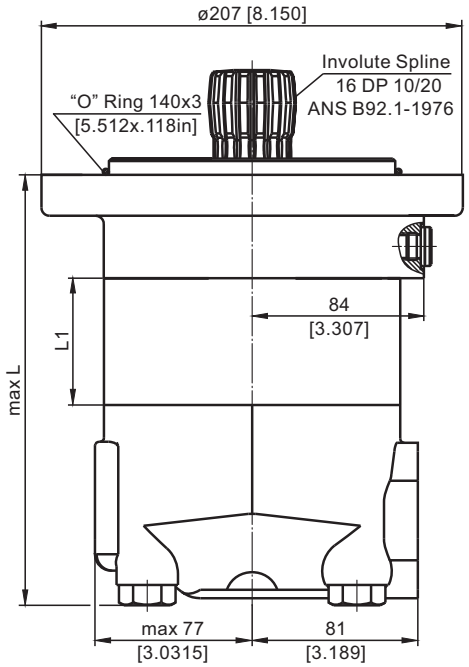
Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

DIMENSIONS and MOUNTING

S Short Mount

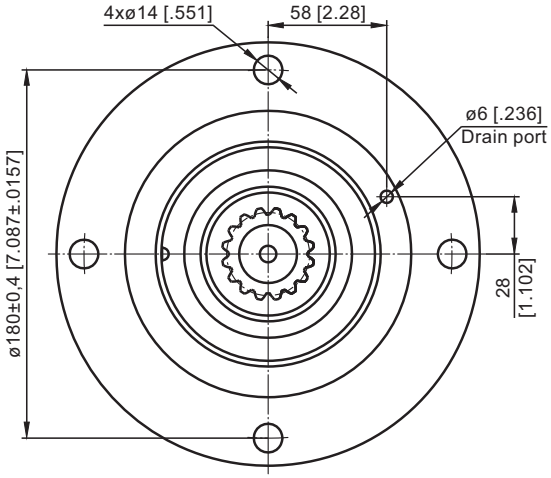




C : 4xM12 - 12 mm [.47 in] depth
P(A,B): 2xG1 - 20 mm [.79 in] depth
T : G 1/4 - 12 mm [.47 in] depth

Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**

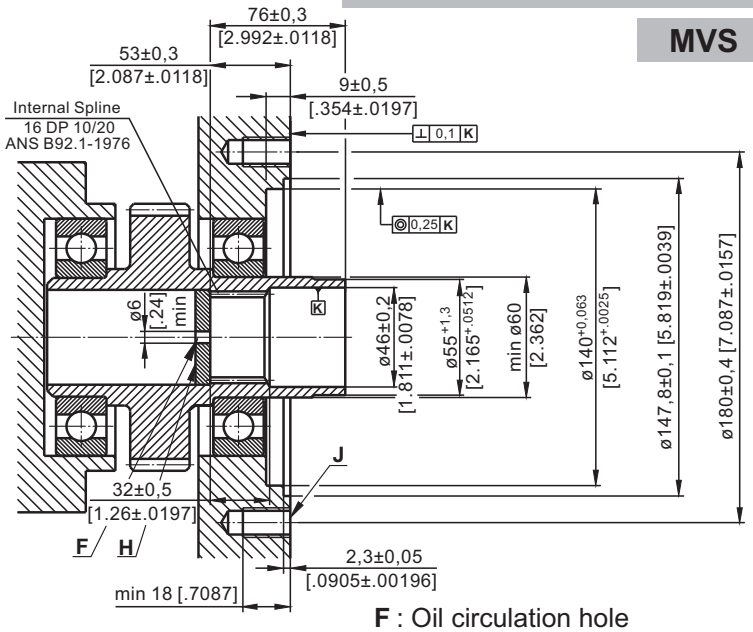


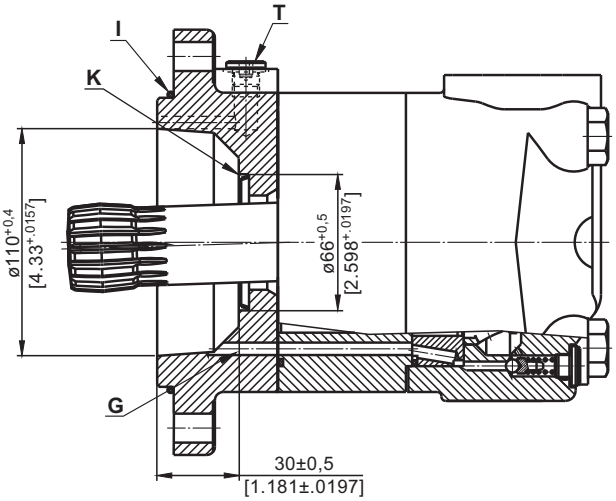
Type	L, mm [in]	L2, mm [in]	*L1, mm [in]
MVS 315	171 [6.73]	117 [4.61]	22,0 [.87]
MVS 400	179 [7.05]	124 [4.88]	29,0 [1.14]
MVS 500	186 [7.32]	132 [5.20]	37,0 [1.46]
MVS 630	197 [7.76]	143 [5.63]	47,5 [1.87]
MVS 800	211 [8.31]	157 [6.18]	61,5 [2.42]

* The width of the roll-gerotor is 4 mm [.157 in] greater than L1.

DIMENSIONS of the ATTACHED COMPONENT

MVS



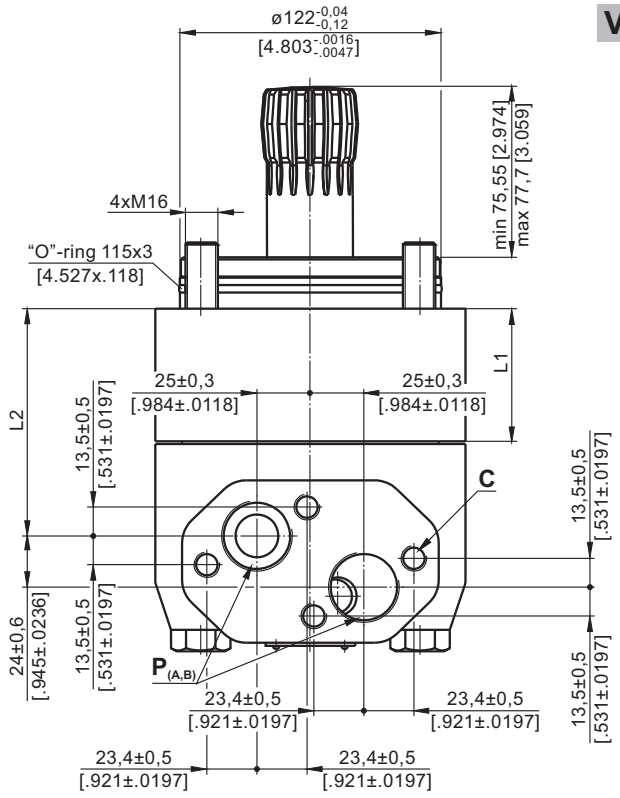


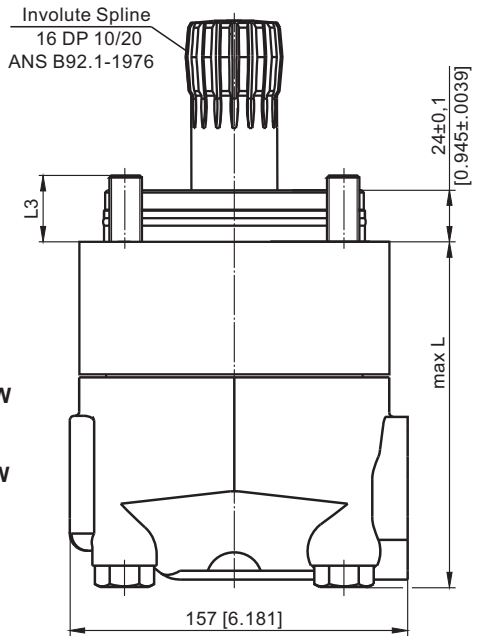
F : Oil circulation hole
G: Internal drain channel
H: Hardened stop plate
I : O-Ring 140x3mm [5.512x.118in]
J : 4xM12-18 mm [.709 in] depth, 90°
K: Conical seal ring
T: Drain connection G1/4 - 12 mm [.47 in] depth

mm [in]

DIMENSIONS and MOUNTING

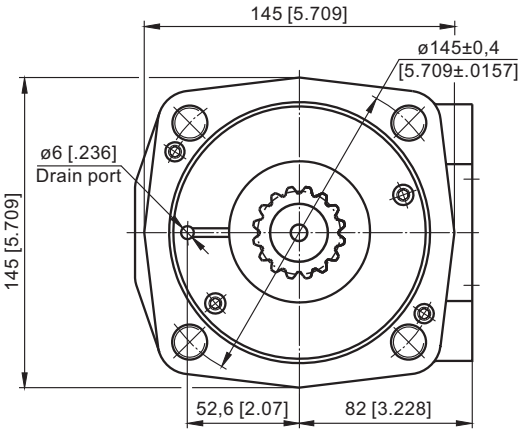
V Very Short Mount





Standard Rotation
Viewed from Shaft End
Port **A** Pressurized - **CW**
Port **B** Pressurized - **CCW**

Reverse Rotation
Viewed from Shaft End
Port **A** Pressurized - **CCW**
Port **B** Pressurized - **CW**



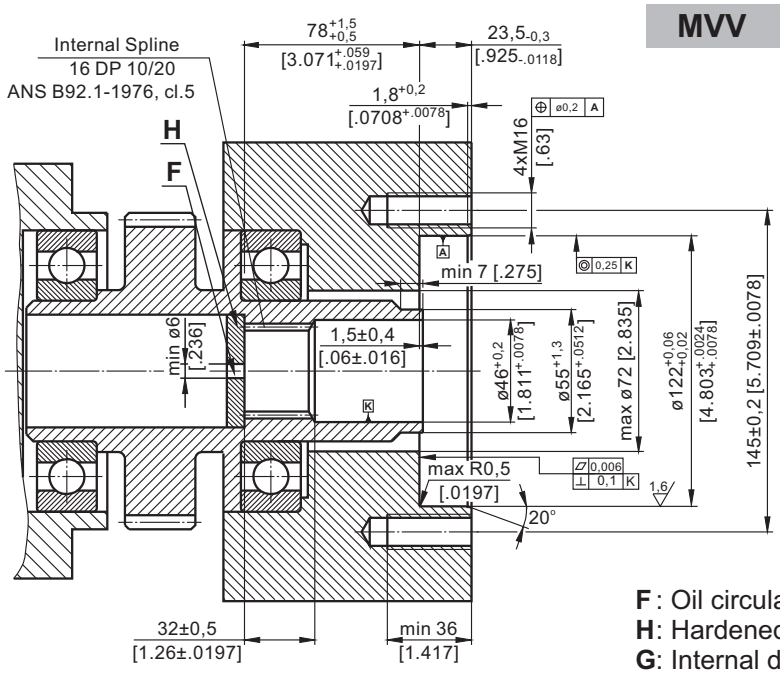
C : 4xM12 - 12 mm [.47 in] depth
P$_{(A,B)}$: 2xG1 - 20 mm [.79 in] depth

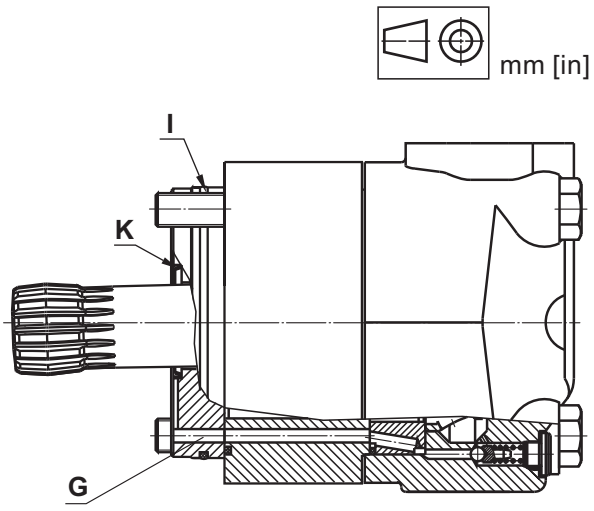
Type	L, mm [in]	L2, mm [in]	L3, mm [in]	*L1, mm [in]
MVV 315	121,5 [4.78]	68,0 [2.68]	29,5 [1.16]	22,0 [.87]
MVV 400	128,5 [5.06]	75,0 [2.95]	32,5 [1.28]	29,0 [1.14]
MVV 500	136,5 [5.37]	83,0 [3.27]	34,5 [1.36]	37,0 [1.46]
MVV 630	147,0 [5.79]	93,0 [3.66]	34,0 [1.34]	47,5 [1.87]
MVV 800	161,0 [6.34]	107,5 [4.23]	30,0 [1.18]	61,5 [2.42]

* The width of the roll-gerotor is 4 mm [.157 in] greater than L1.

DIMENSIONS of the ATTACHED COMPONENT

MVV





mm [in]

F: Oil circulation hole
H: Hardened stop plate
G: Internal drain channel
I : O-Ring 115x3 mm [4.527x.118 in]
K: Conical seal ring

DRAIN CONNECTION

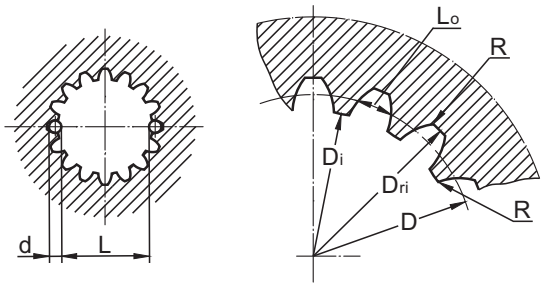
A drain line has to be used when pressure in the return line can exceed the permissible pressure. It can be connected:
- For MVS to the drain port of the motor;
- For MVV to the drain connection of the attached component. The maximum pressure in the drain line is limited by the attached component and its shaft seal.

The drain line must be possible for oil to flow freely between motor and attached component and must be led to the tank. The maximum pressure in the drain line is limited by the attached component and its seal.

INTERNAL SPLINE DATA for the ATTACHED COMPONENT

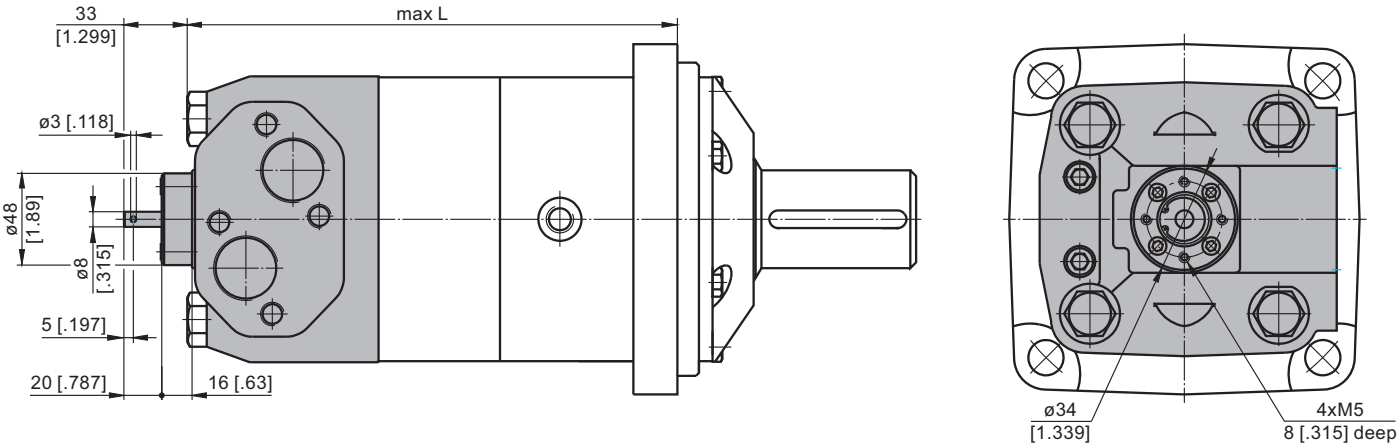
Standard ANS B92.1-1976, class 5
[m=2.54; corrected x.m=+1,0]

Flat Root Side Fit		mm	inch
Number of Teeth	z	16	16
Diametral Pitch	DP	10/20	10/20
Pressure Angle		30°	30°
Pitch Dia.	D	40,640	1.6
Major Dia.	Dri	$45{,}2^{+0{,}4}$	1.796÷1.780
Minor Dia.	Di	$38{,}5^{+0{,}039}$	1.5175÷1.516
Space Width [Circular]	Lo	5,18±0,037	.2055÷.2025
Fillet Radius	R	0,4	.015
Max. Measurement between Pins	L	$32{,}47^{+0{,}15}$	1.284÷1.278
Pin Dia.	d	5,6±0,001	.22051÷.22043



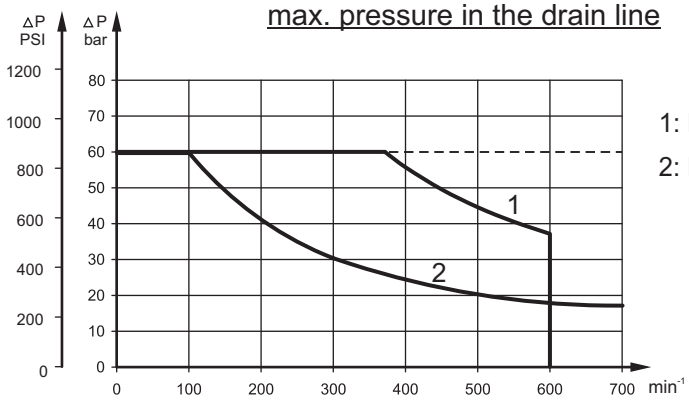
Hardening Specification:
HV=750±50 on the surface.
HV=560 at 0,7±0,2 mm [.035±.019in] case depth
Material: 20 MoCr4 EN 10084 or better.

MOTOR WITH TACHO CONNECTION



MAX. PERMISSIBLE SHAFT SEAL PRESSURE

Max. return pressure without drain line or
max. pressure in the drain line



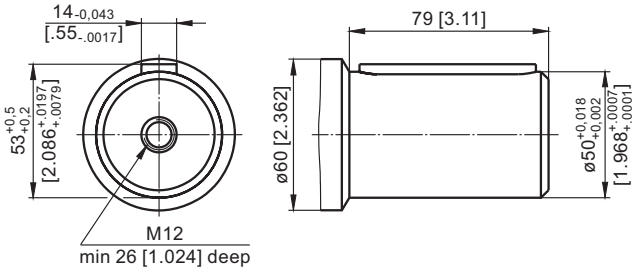
1: Drawing for High Pressure Seal ("U" Seal)
2: Drawing for Standard Shaft Seal

——— - continuous operations
- - - - - - intermittent operations

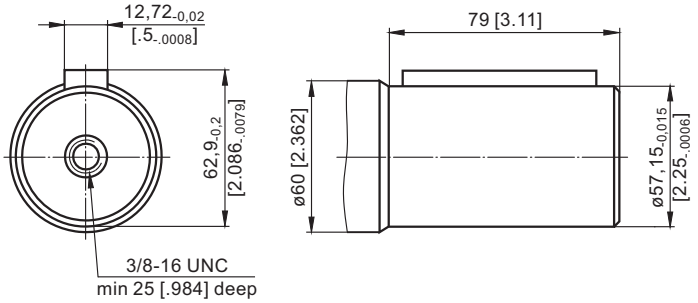
mm [in]

SHAFT EXTENSIONS

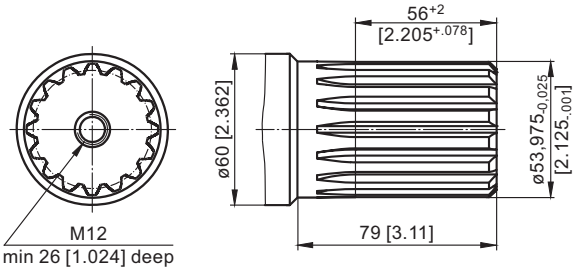
C - ø50 straight, Parallel key A14x9x70 DIN 6885
Max. Torque 271,2 daNm [24000 lb-in]



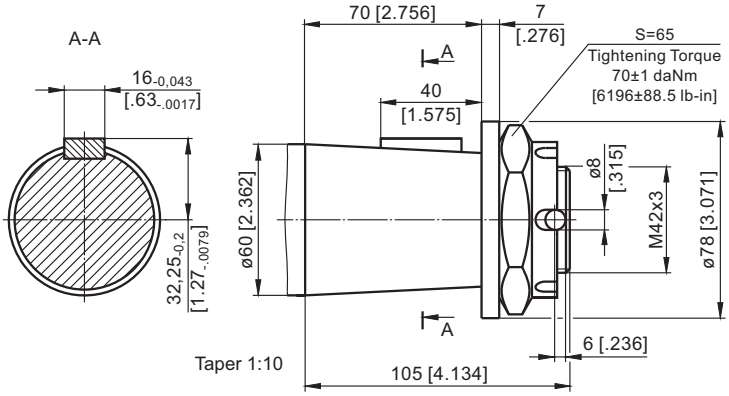
CO - ø2¼" [57,15] straight, Parallel key ½"x½"x 2¼" BS46
Max. Torque 271,2 daNm [24000 lb-in]



SH - ø2 1/8" splined, 16 DP 8/16 ANS B92.1-1976
Max. Torque 271,2 daNm [24000 lb-in]



K - tapered 1:10, Parallel key B16x10x32 DIN 6885
Max. Torque 271,2 daNm [24000 lb-in]



mm [in]

ORDER CODE

	1	2	3	4	5	6
M V						

Pos.1 - Mounting Flange

omit	- Square mount, four holes
C	- SAE C mount
W	- Wheel mount
S	- Short mount
V	- Very short mount

Pos.2 - Displacement code

315	- 314,5 cm³/rev [19.18 in³/rev]
400	- 400,9 cm³/rev [24.45 in³/rev]
500	- 499,6 cm³/rev [30.48 in³/rev]
630	- 629,1 cm³/rev [38.38 in³/rev]
800	- 801,8 cm³/rev [48.91 in³/rev]

Pos.3 - Shaft extensions*

omit	- for **S** and **V** mounting flange
C	- ø50 straight, Parallel key A14x9x70 DIN6885
CO	- ø2¼" straight, Parallel key ½ "x½"x 2¼" BS46
SH	- ø2 1/8" splined, ANS B92.1-1976
K	- ø60 tapered 1:10, Parallel key B16x10x32 DIN6885

Pos.4 - Shaft Seal Version** (see page 49)

omit	- Low pressure shaft seal
U	- High pressure shaft seal

Pos.5 - Additional Options (see page 51)

Pos.6 - Design Series

omit - Factory specified

NOTES:

* The permissible output torque for shafts must not be exceeded!

** Shaft seal is available with the "omit" and "W" mounting flange only!

The hydraulic motors are mangano- phosphatized as standard.

MOTOR ADDITIONAL OPTIONS

Additional Options Description	Order Code	Motor type		
		MS	MT	MV
Speed Sensor*	RS	O	O	O
Tacho Connection**	T	O	O	O
Reinforced motor	HD	–	O	O
Reinforced motor (with check valves)	1HD	–	O	O
Low Leakage	LL	O	O	O
Low Speed Valving	LSV	O	O	O
Reverse Rotation	R	O	O	O
Paint***	P	O	O	O
Corrosion Protected Paint***	PC	O	O	O
Special Paint******	PS	O	O	O
	PCS			

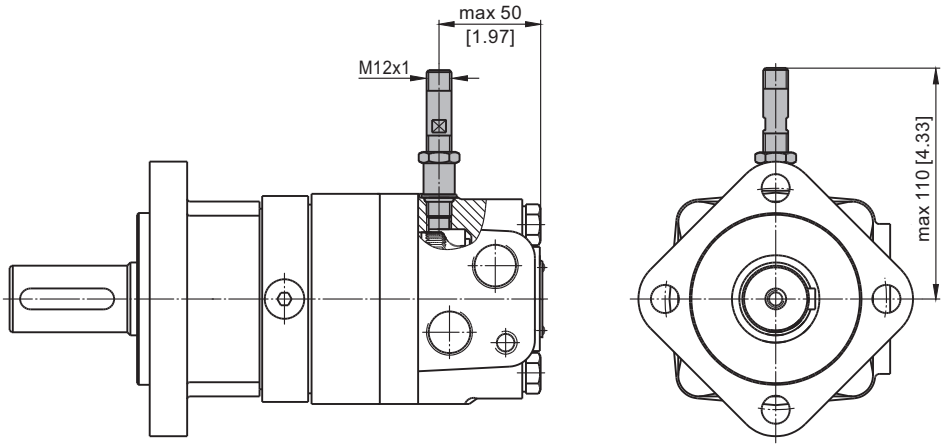
O	Optional
–	Not applicable

* For sensor ordering see pages 52÷53.
** For side ports only!
*** Colour at customer's request.
**** Non painted feeding surfaces, colour at customer's request.

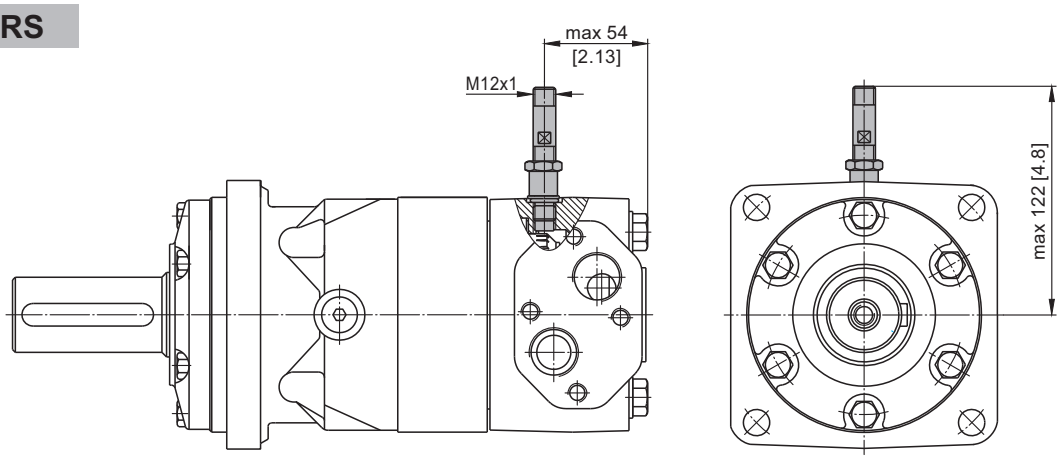
⚠ For more information about HD option please contact with "M+S Hydraulic".

MOTORS WITH SPEED SENSOR

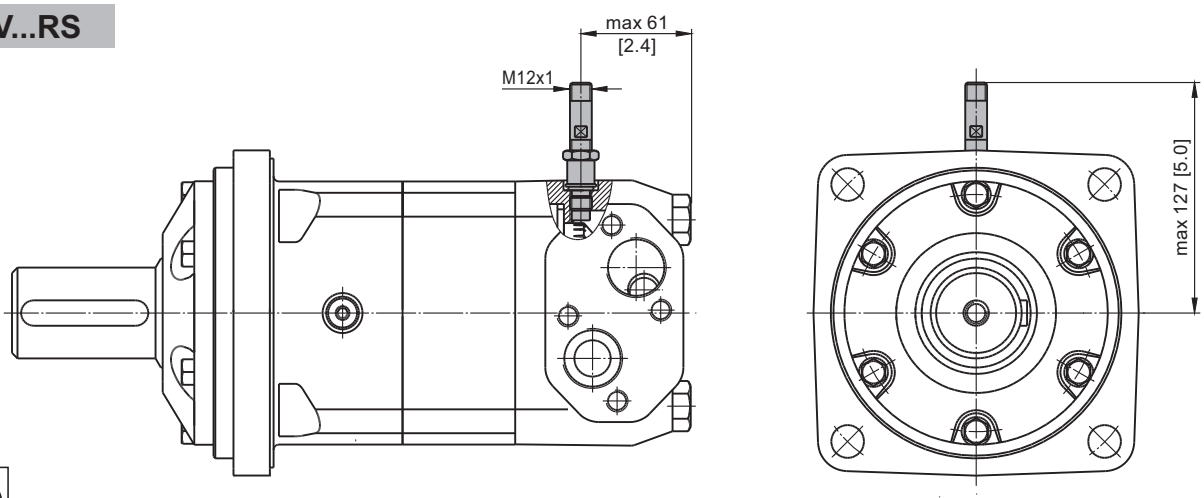
MS...RS



MT...RS



MV...RS



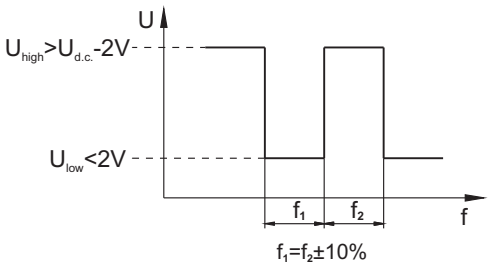
mm [in]

TECHNICAL DATA of the SPEED SENSOR

Technical data

Frequency range	0...15 000 Hz
Output	Universal PUSH PULL
Power supply	10-30 VDC
Current input	<20 mA (@24 VDC)
Maximum output current	500 mA
Ambient Temperature	-40...+125^{0}C [-40...+257^{0}F]
Protection	IP 67
Plug connector	M12-Series
Mounting principle	ISO 6149

Output signal

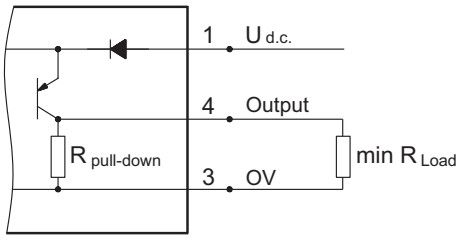


Load max.:I_{high}=I_{low}<50mA

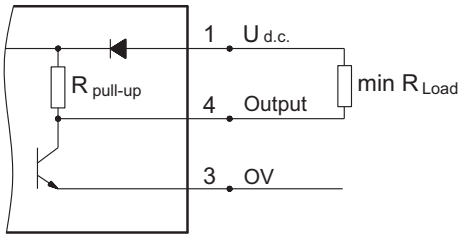
Motor type	MS	MT	MV
Pulses per revolution	54	84	102

Wiring diagrams

PNP

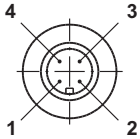


NPN



R_{Load} [kΩ]=$U_{d.c.}$ [V]/I_{max} [mA]

Stick type



Terminal No.	Connection	Cable Output
1	$U_{d.c.}$	Brown
2	No connection	White
3	0V	Blue
4	Output signal	Black

Order Code for Speed Sensor

Sensor Code	Electric connection
RS	Connector BINDER 713 series
RSL2,5	Cable output 3x0,25; 2,5 m [98 in] long
RSL3,5	Cable output 3x0,25; 3,5 m [138 in] long
RSL5	Cable output 3x0,25; 5 m [196 in] long
RSL10	Cable output 3x0,25; 10 m [394 in] long

NOTE: * - The speed sensor is not fitted at the factory, but is supplied in a plastic bag with the motor. For installation see enclosed instructions.

APPLICATION CALCULATION

VEHICLE DRIVE CALCULATIONS

1.Motor speed: n, RPM

$$n = \frac{2{,}65 \times v_{km} \times i}{R_m} \qquad n = \frac{168 \times v_{mi} \times i}{R_{in}}$$

v_{km} - vehicle speed, km/h;
v_{mi} - vehicle speed, mil/h;
R_m - wheel rolling radius, m;
R_{in} - wheel rolling radius, in;
i - gear ratio between motor and wheels.
If no gearbox, use i=1.

2.Rolling resistance: RR, daN [lbs]
The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

G- total weight loaded on vehicle, daN [lbs];
ρ - rolling resistance coefficient (Table 1).

Table 1

Rolling resistance coefficient In case of rubber tire rolling on different surfaces	
Surface	ρ
Concrete- faultless	0.010
Concrete- good	0.015
Concrete- bad	0.020
Asphalt- faultless	0.012
Asphalt- good	0.017
Asphalt- bad	0.022
Macadam- faultless	0.015
Macadam- good	0.022
Macadam- bad	0.037
Snow- 5 cm	0.025
Snow- 10 cm	0.037
Polluted covering- smooth	0.025
Polluted covering- sandy	0.040
Mud	0.037÷0.150
Sand- Gravel	0.060÷0.150
Sand- loose	0.160÷0.300

3.Grade resistance: GR, daN [lbs]

$$GR = G \times (\sin\alpha + \rho \times \cos\alpha)$$

α - gradient negotiation angle (Table 2)

Table 2

Grade %	α Degrees	Grade %	α Degrees
1%	0° 35'	12%	6° 5'
2%	1° 9'	15%	8° 31'
5%	2° 51'	20%	11° 19'
6%	3° 26'	25%	14° 3'
8%	4° 35'	32%	18°
10%	5° 43'	60%	31°

4. Acceleration force: FA, daN [lbs]
Force **FA** necessary for acceleration from 0 to maximum speed **v** and time **t** can be calculated with a formula:

$$FA = \frac{v_{km} \times G}{36 \times t}, [daN] \qquad FA = \frac{v_{mi} \times G}{22 \times t}, [lbs];$$

FA- acceleration force, daN [lbs];
t- time, [s].

5.Tractive effort: DP,daN [lbs]
Tractive effort DP is the additional force of trailer. This value will be established as follows:
-acc.to constructor's assessment;
-as calculating forces in items 2, 3 and 4 of trailer; the calculated sum corresponds to the tractive effort requested.

6.Total tractive effort: TE, daN [lbs]
Total tractive effort **TE** is total effort necessary for vehicle motion; that the sum of forces calculated in items from 2 to 5 and increased with 10 % because of air resistance.

$$TE = 1{,}1 \times (RR + GR + FA + DP)$$

RR - force acquired to overcome the rolling resistance;
GR- force acquired to slope upwards;
FA- force acquired to accelerate (acceleration force);
DP- additional tractive effort (trailer).

7.Motor Torque moment: M, daNm [lb-in]
Necessary torque moment for every hydraulic motor:

$$M = \frac{TE \times R_{in}[R_m]}{N \times i \times \eta_M}$$

N- motor numbers;
η_M - mechanical gear efficiency (if it is available).

8.Cohesion between tire and road covering: M_w, daNm [lb-in]

$$M_W = \frac{G_W \times f \times R_{in}[R_m]}{i \times \eta_M}$$

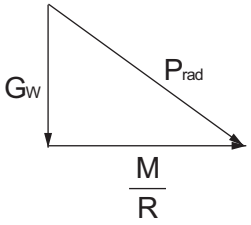
To avoid wheel slipping, the following condition should be observed $M_w > M$
f - frictional factor;
G_w - total weight over the wheels, daN [lbs].

Table 3

Surface	Frictional factor f
Steel on steel	0.15 ÷ 0.20
Rubber tire on polluted surface	0.5 ÷ 0.7
Rubber tire on asphalt	0.8 ÷ 1.0
Rubber tire on concrete	0.8 ÷ 1.0
Rubber tire on grass	0.4

9.Radial motor loading: P_{rad} , daN [lbs]

When motor is used for vehicle motion with wheels mounted directly on motor shaft, the total radial loading of motor shaft P_{rad} is a sum of motion force and weight force acting on one wheel.



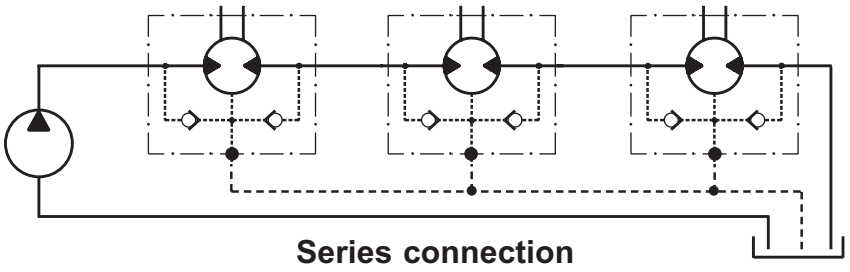
$$P_{rad}=\sqrt{G_w^2+\left(\frac{M}{R}\right)^2}$$

G_w - Weight held by wheel;
P_{rad} - Total radial loading of motor shaft;
M/R- Motion force.

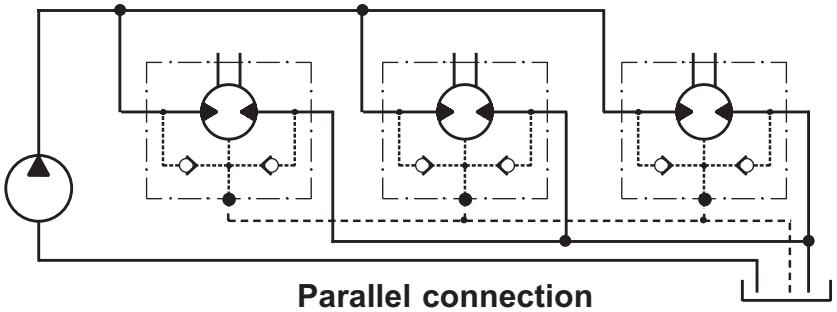
In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

Advantages in oil drainage from drain space: Cleaning; Cooling and Seal lifetime prolonging.



Series connection



Parallel connection